1361553

PATENT SPECIFICATION (11) 1361553

(21) Application No. 43936/72 (22) Filed 22 Sept. 1972
(61) Patent of Addition to No. 1292800 dated 11 May 1970
(44) Complete Specification published 24 July 1974
(51) International Classification F16C ~~33/58 33/32~~ 33/62
(52) Index at acceptance
F2A D54 D66
C7A 741 742 750 77X 780 A249 A279 A28X A28Y A329 A339 A349 A369 A389 A409 A439 A459 A509 A529 A53Y A579 A599 A609 A629 A671 A673 A675 A677 A679 A67X A681 A683 A685 A687 A689 A68X A693 A895 A697 A699 A69X A70X

(19) THE PATENT OFFICE LONDON

(54) ANTI-FRICTION BEARING COMPONENT MANUFACTURE

(71) We, FORD MOTOR COMPANY LIMITED, of 88 Regent Street, London, W.1., a British Company, do hereby declare the invention, which was communicated from Ford Motor Company of 23400 Michigan Avenue, Village Plaza, Dearborn, Michigan 48123, United States of America, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the production of bearing components for anti-friction bearings and is concerned with an improvement in or modification of the invention forming the subject matter of our Application No. 22624/70 (Serial number 1292800).

Anti-friction bearings, and more particularly ball bearings, have been the object of intensive research in recent years. This research plus the advent of very clean vacuum degassed steels have resulted in the production of bearings of much longer dependable life and higher load carrying ability.

The critical element in ball bearings insofar as failure is concerned is almost inevitably the inner race. The inner races fail in fatigue as the result of the repeated application of extremely high compressive loads locally when a bearing ball passes over the race.

The ball bearings employed in the automotive industry are almost invariably prepared from a steel designated commercially as SAE 52100. This is an economical hypereutectoid steel containing one per cent of carbon and about one and one-half per cent chromium as the principal alloying ingredients. This steel is purchased in the form of seamless tubing and the individual inner race blanks are obtained by cutting off lengths of this tubing. These lengths must be machined, heat treated and ground to size to form the finished inner race.

In our copending Application No. 22624/70, (Serial number 1,292,800) there is described and claimed a process of preparing bearing components for anti-friction bearings comprising heating a blank of SAE 52100 steel to a temperature resulting in a completely austenitic structure, cooling the austenitized blank sufficiently rapidly to avoid the formation of any massive carbides and to yield a finely divided pearitic structure, annealing the cooled blank at a temperature from 1200° to 1550°F. for a time sufficient to produce a spheroidized structure of which the carbide particles range downward in size from a maximum of one micron, hardening the annealed blank by heating to a temperature and for a time period insufficient to produce carbide growth, but sufficient to establish a thermodynamic equilibrium between austenite and undissolved carbide and by quenching the heated blank in air or a coolant producing a cooling rate approximating that of oil and finally tempering the quenched blanks to a Rockwell C hardness of 60 to 64.

It has now been found, in accordance with the present invention, that it is possible to omit the annealing step described above where the bearings are subsequently finished by grinding rather than by machining and grinding. In other words, it is not necessary to have a spheroidizing step where no subsequent machining is required.

In the embodiment of the invention described below the ball bearing race is formed by a procedure which has been modified to increase the B-10 life of these inner races by a factor of 2 or more. The B-10 life of anti-friction bearings is defined as the time required to fail ten percent of any given bearing population when tested under carefully standardized and controlled conditions.

The steel employed for the production of inner races according to this invention is also SAE 52100, and is obtained in the form of rolled tubing. The microstructure of this stock tubing is not critical to this invention and either a hot rolled or spheroidized annealed structure is acceptable. If pre-machining is de-

sirable, a spheroidized structure is preferable.

The first step in the heat treating process is to heat the individual race blanks which have been severed from the tubing stock to a temperature at which the carbon content of the alloy is completely soluble in the gamma iron or austenite. This includes temperatures from 1750°F. up to temperatures limited only by grain growth and the melting point of the steel. In actual practice a temperature of 2000°F. has been employed. A protective atmosphere such as nitrogen is essential to prevent scaling or decarburization. After all of the carbon has been dissolved in the austenite, the tubing is cooled sufficiently rapidly to avoid precipitation of massive carbides along the austenite grain boundaries. Air cooling from 2000F. is sufficiently rapid for this purpose. This air cooling step will produce a very fine pearlitic structure which is difficult to machine.

The annealed inner race blanks from the first step must be hardened and ground. To harden these races they are austenized by heating quickly to a temperature in the range of 1525° to 1600°F. and preferably to 1550°F. for about one hour. At this temperature austenite of approximately 0.60 per cent carbon is in equilibrium with the undissolved carbides, When the races have become fully austenitized, they are quenched in oil and then tempered to a final hardness of R_c60 to 64 by a tempering treatment of 250° to 400°F.

Bearing races fabricated according to this process exhibit a B-10 life of 2 or more times as great as conventional processing.

This invention has been described particularly in connection with the production of anti-friction bearing inner races in contradistinction to the balls and the outer races.

This is because the inner race durability is normally the factor limiting the life of anti-friction bearings. However, the sharp improvement effected by the application of the process of this invention to inner races may well shift the Achilles' heel of the bearing as a unit to the balls or the outer race. In this event further improvement in bearing life may be obtained by applying this process to the balls or the outer races and such is clearly within the scope of this invention.

The following publications will assist in understanding the invention:—

Bamberger, E. N.: "The Effect of Ausforming on the Rolling Contact Fatigue Life of a Typical Bearing Steel," *Transactions of the ASME Journal of Engineering for Power*, Paper No. 65-Lub-9, pp. 1-10, October 1965.

Bush, J. J., Grube, W. L., Robinson, G. H.: "Microstructural and Residual Stress Changes in Hardened Steel due to Rolling Contact," *Procedure of a Symposium on Rolling Contact Phenomena*, pp. 365—399, October 1960, Elsevier Publishing Company, New York, 1962.

WHAT WE CLAIM IS:—

1. The process of preparing bearing components for anti-friction bearings comprising heating a blank of SAE steel 52100 to a temperature resulting in a completely austenitic structure, cooling the austenitized blank sufficiently rapidly to avoid the formation of any massive carbides and to yield a finely divided pearlitic structure, hardening the cooled blank (without any annealing thereof) by heating to a temperature and for a time period insufficient to produce carbide growth, but sufficient to establish a thermodynamic equilibrium between austenite and undissolved carbide and by quenching the heated blank in oil or a coolant producing a cooling rate approximating that of oil and finally tempering the quenched blank to a Rockwell C hardness of 60 to 64.

2. The process recited in Claim 1 in which the hardening is at a temperature of 1550°F for about one hour.

3. The process recited in Claim 1 in which the temperature employed for hardening is between 1525° and 1600°F.

4. The process as claimed in any one of the preceding claims in which the bearing components are inner bearing races.

5. The process claimed in any one of the preceding claims in which the blank is a length of rolled tubing.

6. A process for preparing a bearing component for an anti-friction bearing substantially as hereinbefore described.

7. A bearing component made by the process claimed in any one of the preceding claims.

MARKS & CLERK,
Chartered Patent Agents,
57 & 58 Lincoln's Inn Fields,
London, WC2A 3LS
Agents for the Applicant(s).

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1974.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.